DEREE COLLEGE SYLLABUS FOR: MA 3323 Elementary Differential Equations

US CREDITS: 3/0/3

(Fall 2022)

PREREQUISITES:

MA 1008 College Algebra
MA 2130 Calculus I **or** MA2105 Applied Calculus
MA 2240 Calculus II

CATALOG DESCRIPTION:

An introduction to methods for solving (ordinary) differential equations with constant or variable coefficients. First order differential equations including linear, exact, and separable equations. Euler's method for approximate solutions. Solutions of higher order linear differential equations using undetermined coefficients, variation of parameters, power series, and the Laplace Transform. Solutions of systems of linear equations, eigenvalues and eigenvectors, with application to a range of modeling-based applications arising in the context of engineering and sciences.

RATIONALE:

This mathematics module aims to introduce the concepts of linear and non-linear ordinary differential equations and the techniques that are necessary for modeling physical and other phenomena through various calculus related methods. The knowledge gained in this course will allow students to develop skills in formulating differential equation models to address problems arising in engineering, physics, computer science, and other applied areas.

LEARNING OUTCOMES:

Upon successful completion, the students should be able to:

1. Demonstrate understanding of the concepts of differential equations and initial value problems, and solve different types of first order differential equations with constant coefficients.
2. Solve differential equations of higher order by various methods with modeled applications to engineering and sciences.
3. Solve second order differential equations with variable coefficients.
4. Apply the Laplace Transform to solve initial value problems.
5. Solve systems of linear differential equations with modeled applications to engineering and sciences.

METHOD OF TEACHING AND LEARNING:

In congruence with the teaching and learning strategy of the college, the following tools are used:

- Classes will consist of lectures where the concepts of the course will be introduced. Coursework will be regularly assigned and discussed in class with students actively participating in the discussion. Computer software will be available both as a teaching aid and as the medium for solving problems.
- Office hours: students are encouraged to make full use of the office hours of their instructor, where they can ask questions, see their exam paper, and/or go over lecture material.
- Use of a blackboard site, where instructors post lecture notes, assignment instructions, timely announcements, as well as additional resources.

ASSESSMENT:

Summative:

First Assessment: Midterm Examination	**40%**	Solving differential equations and initial value problems.
Second Assessment: Portfolio	**10%**	Exercises/problems and modeled applications using software.
Final Assessment: Final Examination	**50%**	Solving differential equations and initial value problems.

Formative:

Online exercises and word problems assigned through Blackboard.	**0%**	Solving differential equations and initial value problems.

- The first assessment (midterm exam) tests Learning Outcomes 1 and 2.
- The second assessment (portfolio) tests Learning Outcomes 1, 2, 3, 4, 5.
- The final assessment (final exam) tests Learning Outcomes 1, 2, 3, 4, 5.
- The formative assessment aims to prepare students for the examinations.

The final grade for this module will be determined by averaging all summative assessment grades, based on the predetermined weights for each assessment. Students are not required to resit failed assessments in this module. Failure to pass the module results in module repeat.

INDICATIVE READING:	**REQUIRED READING:** Dennis G. Zill, *A First Course in Differential Equations with Modeling Applications,* 11th Edition (International Metric Edition), 2018, Cengage, (WebAssign e-textbook) **RECOMMENDED READING:** • W.E. Boyce, R.C. DiPrima, D.B. Meade, *Elementary Differential Equations*, 11th Edition, 2016, Wiley
INDICATIVE MATERIAL:	**REQUIRED MATERIAL:** N/A **RECOMMENDED MATERIAL:** • College Mathematics • Mathematics Magazine • American Mathematical Monthly
COMMUNICATION REQUIREMENTS:	Oral and written communication skills using academic / professional English.
SOFTWARE REQUIREMENTS:	Any software distributed with the course textbook. Opensource math software *Scilab* (www.scilab.org)
WWW RESOURCES:	http://mathworld.wolfram.com http://sosmath.com https://www.khanacademy.org/math https://www.symbolab.com
INDICATIVE CONTENT:	**1. First Order Differential Equations** 1.1 Classification of Differential Equations (DEs) 1.2 Initial value problems and DEs as mathematical models 1.3 Direction fields and autonomous first order DEs 1.4 Separable equations 1.5 Linear equations and Exact equations 1.6 Solutions by substitutions 1.7 Numerical solutions – The Euler's method 1.8 Applications of first order DEs **2. Higher Order Linear Differential Equations** 2.1 Solutions of linear equations 2.2 Reduction of order 2.3 Homogeneous linear equations with constant coefficients 2.4 Undetermined coefficients 2.5 Variation of parameters 2.6 Cauchy-Euler equations 2.7 Applications of higher order DEs – Spring/Mass systems **3. Series Solutions of Linear Differential Equations** 3.1 Review of power series 3.2 Solutions about ordinary points 3.3 Solutions about stationary points **4. The Laplace Transform** 4.1 Definition of the Laplace Transform 4.2 Inverse transforms and transforms of derivatives 4.3 Operational properties 4.4 Applications of the Laplace Transform **5. Systems of Linear First Order Differential Equations** 5.1 Review of Matrices – Linear systems 5.2 Homogeneous linear systems: Eigenvalues, Eigenvectors 5.3 Applications of systems with linear DEs